WHAT IS CLAIMED IS:

1. In combination for etching an insulating layer in a wafer to present a clean and fresh surface on the insulating layer for deposition,

a conduit for molecules of an inert gas,

a first electrode biased to a first voltage and spaced from the wafer,

a second electrode biased to a second voltage lower than the first voltage and spaced from the first electrode and the wafer,

magnetic members providing a magnetic field,

the first electrode and the magnetic members being disposed relative to each other and to the molecules of the inert gas for ionizing the molecules of the inert gas, and

the second electrode and the wafer being disposed relative to each other and to the ions of the inert gas to obtain a movement of the ions to the wafer at a low and controlled speed for an etching of the surface of the insulating layer by the ions at the low and controlled speed.

2. In a combination as set forth in claim 1,

a first member disposed adjacent the first electrode for providing a reference potential different from the bias on the first electrode to create a first electrical field, and

a second member disposed adjacent the second electrode for providing the reference potential to create a second electrical field,

the first electrical field and the magnetic field being disposed relative to each other and to the molecules of the inert gas from the supply for ionizing the molecules of the inert gas,

the second electrical field and the magnetic field being disposed relative to each other and to the ions of the inert gas to obtain the movement of the ions to the wafer at the low and controlled speed.

3. In a combination as set forth in claim 1,

a first source of alternating voltage for creating the bias on the first electrode, the bias on the first electrode being a negative direct voltage,

a second source of alternating voltage for creating the bias on the second electrode, the bias on the second electrode being a negative direct voltage.

4. In a combination as set forth in claim 1,

the first electrode being disposed in a substantially parallel and contiguous relationship to the wafer,

there being a path for the flow of the argon molecules from the vicinity of the first and second electrodes and the magnetic members.

5. In a combination as set forth in claim 1,

the wafer being at a floating potential,

there being first and second electrically conductive members respectfully adjacent the first and second electrodes at a reference potential to provide for the creation of electrical fields respectively between the first electrode and the first electrically conductive member and between the second electrode and the second electrically conductive member.

6. In a combination as recited in claim 2,

a first source of alternating voltage for creating the bias on the first electrode, the bias on the first electrode being a negative direct voltage,

a second source of alternating voltage for creating the bias on the second electrode, the bias on the second electrode being a negative direct voltage,

the first electrode being disposed in a substantially parallel and contiguous relationship to the wafer,

there being a path for the flow of the argon molecules from the vicinity of the first and second electrodes and the magnetic members,

the wafer being at a floating potential,

there being first and second electrically conductive members respectfully adjacent the first and second electrodes at a reference potential to provide for the creation of

electrical fields respectively between the first electrode and the first electrically conductive member and between the second electrode and the second electrically conductive member.

7. In combination for etching an insulating layer in a wafer to present a clean and fresh surface on the insulating layer for deposition,

an enclosure defined by magnetic members forming a magnetic field and by first and second electrodes spaced from each other and from the wafers and providing electrical fields,

a supply of molecules of an inert gas for introducing the molecules into the enclosure,

a first source of an alternating voltage for producing a direct negative voltage of a high magnitude on the first electrode for the creation of a first electrical field of a high magnitude in the enclosure,

a second source of an alternating voltage for producing a direct negative voltage of a low magnitude on the second electrode for the creation of a second electrical field of a low magnitude in the enclosure,

the molecules of the inert gas in the enclosure being ionized by the combination of the electrical and magnetic fields, and

the wafer being disposed relative to the second electrode and relative to the argon ions in the enclosure to receive an etching of a low magnitude on the surface of the insulating layer by the argon ions in the enclosure.

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8. In a combination as set forth in claim 7,

an opening in the enclosure for the flow of the molecules and ions of the inert gas from the enclosure,

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the first source of the alternating voltage being operative to produce a direct voltage of the high magnitude and a negative polarity at the first electrode,

the second source of the alternating voltage being operative to produce a direct voltage of the low magnitude and a negative polarity at the second electrode.

9. In a combination as set forth in claim 7,

a first electrical conductor disposed in adjacent relationship to the first electrode at a particular reference potential to produce a first electrical field between the first electrode and the first electrical conductor, and

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a second electrical conductor disposed in adjacent relationship to the second electrode at the particular reference potential to produce a second electrical field between the second electrode and the second conductor.

10. In a combination as set forth in claim 7,

the wafer being disposed between the first and second electrodes in a substantially parallel relationship to the first and second electrodes and closer to the second electrode than the first electrode,

the wafer being at a floating potential relative to the negative potentials on the first and second electrodes and relative to the reference potential.

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11. In a combination as set forth in claim 7,

the wafer being disposed in a spaced, but contiguous, relationship to the second electrode to create a first capacitor between the second electrode and the wafer and to create a second capacitor between the wafer and the ions of the inert gas in the enclosure.

12. In a combination as set forth in claim 10,

a vacuum pump for producing a vacuum in the enclosure, there being a space between the second electrode and the second conductive member for the flow of the molecules and ions of the inert gas from the enclosure.

13. In a combination as set forth in claim 10,

a first electrical conductor disposed in adjacent relationship to the first electrode at a particular reference potential to produce a first electrical field between the first electrode and the first electrical conductor,

a second electrical conductor disposed in adjacent relationship to the second electrode at the particular reference potential to produce a second electrical field between the second electrode and the second conductor.

the wafer being disposed in a spaced, but contiguous, relationship to the second electrode to create a first capacitor between the second electrode and the wafer and to create a second capacitor between the wafer and the ions of the inert gas in the enclosure.

14. In combination for etching an insulating layer in a wafer disposed in an enclosure to present a clean and fresh surface on the insulating layer for deposition,

magnetic members defining a magnetic field in the enclosure,

a first source of an alternating voltage for providing a first electrical field of a high magnitude in the enclosure,

a first electrode forming a part of the enclosure and connected to the first source of voltage for providing a negative DC voltage of a relatively high magnitude at a first position in the enclosure,

a second source of an alternating voltage for providing a second electrical field of a low magnitude in the enclosure,

a second electrode forming a part of the enclosure and connected to the second source of the alternating voltage for providing a negative DC voltage of a relatively low magnitude at a second position displaced from the first position and the wafer but near the first wafer,

a conduit for introducing molecules of an inert gas into the enclosure for ionization by the combination of the electrical and magnetic fields to produce ions of high density,

the second electrode and the wafer providing a first capacitor of a high impedance, and the wafer and the ions in the enclosure providing a second capacitor of a low impedance in a circuit to produce a current of a low magnitude for etching the surface of the insulating layer in the wafer.

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15. In a combination as set forth in claim 14,

the first capacitor providing a dielectric of the molecules and ions of the inert gas and the second capacitor providing a dielectric constituting the insulating layer.

16. In a combination as set forth in claim 14,

a first electrically conductive member disposed in adjacent relationship to the first electrode and having a reference potential to provide an electrical field between the first electrode and the first electrically conductive member, and

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a second electrically conductive member disposed in adjacent relationship to the second electrode and having the reference potential to provide an electrical field between the second electrode and the second electrically conductive member.

17. In a combination as set forth in claim 14,

the wafer having a floating potential and being disposed between the first and second electrodes in closer proximity to the second electrode than to the first electrode and being substantially parallel to the first and second electrodes.

~~18. In a combination~~ as set forth in claim 17,

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the conduit being disposed adjacent the first electrode to introduce the molecules of the inert gas into the enclosure and the molecules and ions of the inert gas being passed from the enclosure at a position adjacent to the second electrode.

19. In a combination as set forth in claim 14,

the magnetic members being disposed in a direction substantially perpendicular to the first and second electrodes to produce a helical movement of electrons in the enclosure and to provide for the production of the ions from the molecules of the inert gas by the helical movement of the electrons.

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20. In a combination as set forth in claim 13,

a first electrically conductive member disposed in adjacent relationship to the first electrode and having a reference potential to provide an electrical field between the first electrode and the first electrically conductive member,

a second electrically conductive member disposed in adjacent relationship to the second electrode and having the reference potential to provide an electrical field between the second electrode and the second electrically conductive member,

~~the wafer having a floating~~ potential and being disposed between the first and second electrodes in closer proximity to the second electrode than to the first electrode and being substantially parallel to the first and second electrodes,

the conduit being disposed adjacent the first electrode to introduce the molecules of the inert gas into the enclosure and the molecules and ions of the inert gas being passed from the enclosure at a position adjacent to the second electrode,

the magnetic members being disposed in a direction substantially perpendicular to the first and second electrodes to produce a helical movement of electrons in the enclosure and to provide for the production of the ions from the molecules of the inert gas by the helical movement of the electrons.

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21. In combination for etching an insulating layer in a wafer to present clean and fresh surfaces on the insulating layer for deposition,

an enclosure defined by first and second electrodes displaced from each other and from the wafer for producing electrical fields in the enclosure and further defined by magnetic members for producing a magnetic field in the enclosure,

a first voltage source for producing a voltage of a high magnitude on the first electrode to obtain a production of a high electrical field in the enclosure,

a second voltage source for producing a voltage of a low magnitude on the second electrode to obtain a production of a low electrical field in the enclosure, and

a supply of molecules of an inert gas for introduction into the enclosure to obtain an ionization of the gas molecules in the enclosure by the electrical and magnetic fields in the enclosure and to obtain a movement of the ions in the enclosure to the insulating layer in the wafer at a speed to obtain a smooth and even etching of the surface of the insulating layer at a low rate without any pits in the surface of the insulating layer.

22. A method of etching an insulating layer in a wafer to present a clean and fresh surface on the insulation layer for a deposition on the insulating layer, including the steps of:

providing a relatively strong electrical field at first positions in an enclosure,

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providing a relatively weak electrical field at second positions displaced in the enclosure from the first positions, the relatively weak electrical fields defining a capacitor with a high impedance to limit the transfer of electrical charges to the insulating layer in the wafer,

passing molecules of an inert gas through the enclosure, and

providing a magnetic field in the enclosure in a direction relative to the strong electrical field to obtain a movement of electrons in the enclosure at the positions of the strong electrical field and an ionization of molecules of the inert gas by the electrons and a movement of the ions in a direction relative to the weak electrical field to obtain a movement of the ions, in accordance with the high impedance of the capacitor defined by the relatively weak field, to the second electrode at a speed for etching the surface of the insulating layer on the wafer substantially uniformly without pitting the insulating layer.

23. A method as set forth in claim 22 wherein

the relatively strong electrical field is provided in a first direction and

the relatively weak electrical field is provided in a second direction opposite to the first direction and wherein

the magnetic field is provided in a direction transverse to the first and second directions to produce a movement of the electrons in the enclosure in a helical path for facilitating the ionization of molecules of the inert gas in the enclosure.

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24. A method as set forth in claim 22

the wafer is disposed in the weak electrical field and wherein

the molecules of the inert gas are passed through the enclosure initially to positions in the strong electrical field to obtain an ionization of molecules of the inert gas and subsequently through the enclosure to positions in the weak electrical field to facilitate an etching of the surface of the insulating layer on the wafer by the ions.

25. A method as set forth in claim 22 wherein

the wafer is disposed in the relatively weak electrical field and wherein

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an electrode providing the relatively weak field is spaced from, but disposed relatively close to, the wafer to cooperate with the wafer in providing a high impedance in the capacitor and a circuit including the capacitor for attracting the ions in the weak electrical field to the wafer to etch the surface of the insulating layer on the wafer without pitting the insulating layer.

26. A method as set forth in claim 21 wherein

the capacitor constitutes a first capacitor and wherein

the relatively weak electrical field is defined by the first capacitor and a second capacitor in a series circuit and wherein

the first capacitor is defined by plates constituting an electrode and the wafer and in which the plates are separated by a space in which molecules and ions of the inert gas are disposed to define the insulator for the capacitor and to provide the first capacitor with the high impedance and wherein

a second capacitor is defined by plates constituting the wafer and the ions of the inert gas in the enclosure and wherein the plates are separated by the insulating layer in the wafer to define the insulator of the second capacitor and to provide the second capacitor with a relatively low impedance in comparison to the high impedance of the first capacitor.

27. A method as set forth in claim 26 wherein

the relatively strong electrical field is provided by a first electrode and a first alternating voltage providing a relatively high negative bias on the first electrode and wherein

the relatively weak electrical field is provided by a second electrode and by a second alternating voltage providing a relatively low bias on the second electrode.

28. A method as set forth in claim 26 wherein

the wafer is disposed in the weak electrical field and wherein

the molecules of the inert gas are passed through the enclosure initially through positions in the strong electrical field to obtain an ionization of molecules of the inert gas and subsequently through positions in the weak electrical field to facilitate an etching of the surface of the insulating layer on the wafer by the ions and wherein

the wafer is disposed in the relatively weak electrical field and wherein

an electrode providing the relatively weak field is spaced from, but disposed relatively close to, the wafer to cooperate with the wafer in providing a high impedance in the capacitor and a circuit including the capacitor for attracting the ions in the weak electrical field to the wafer to etch the surface of the insulating layer on the wafer without pitting the insulating layer.

29. A method as set forth in claim 26 wherein

the capacitor constitutes a first capacitor and wherein

the first capacitor and a second capacitor are in series and wherein

the first capacitor is defined by plates constituting an electrode and the wafer and in which the plates are separated by a space in which molecules and ions of the inert gas are disposed to define the insulator for the capacitor and to provide the high impedance and wherein

the second capacitor is defined by plates constituting the wafer and the ions of the inert gas in the enclosure and wherein the plates are separated by the insulating layer in the wafer to define the insulator of the second capacitors and to provide a relatively low impedance in comparison to the high impedance of the first capacitor and wherein

the relatively strong electrical field is provided by a first electrode and a first alternating voltage providing a relatively high negative bias on the first electrode and wherein

the relatively weak electrical field is provided by a second electrode and by a second alternating voltage providing a relatively low bias on the second electrode.

30. A method of etching an insulating layer on a wafer to present a clean and fresh surface on the insulating layer for deposition, including the steps of

passing molecules of an inert gas through an enclosure,

disposing a first electrode in the enclosure to provide a strong electrical field in a first direction at first positions in the enclosure to ionize molecules of the inert gas in the enclosure,

disposing a second electrode in the enclosure to provide a weak electrical field at second positions in the enclosure in a second direction opposite to the first direction,

providing a magnetic field in the enclosure, in a direction transverse to the first and second directions, to cooperate with the strong electrical field in producing charged particles in the enclosure and to cooperate with the weak electrical field in producing a transfer

of the charged particles to the surface of the insulating layer in the wafer to provide a weak and controlled etching of the surface of the insulating layer without producing pits in the surface of the insulating layer.

31. A method as set forth in claim 30 wherein

the molecules of the inert gas pass through the enclosure from the strong electrical field to the weak electrical field and wherein

the magnetic field is substantially perpendicular to the first and second electrical fields.

32. In a combination in claim 30 wherein

the strong electrical field is defined in part by the first electrode and by an alternating voltage applied at a first magnitude to the first electrode to bias the first electrode at a negative DC potential with a first magnitude and wherein

the weak electrical field is defined in part by the second electrode and by an alternating voltage applied to the second electrode at a second magnitude less than the first magnitude to bias the second electrode at a negative DC potential with a second magnitude less than the first magnitude for producing the transfer of the charged particles to the surface of the wafer to provide the weak and controlled etching of the surface of the insulating layer without producing pits in the surface of the insulating layer.

33. In a combination as set forth in claim 30 wherein

the magnetic field is provided by magnetic members and wherein

the magnetic members and the first and second electrodes define the enclosure.

34. In a combination as set forth in claim 30 wherein

the wafer is disposed in the weak electrical field and is separated from the second electrode in the weak electrical field.

35. In a combination as set forth in claim 30 wherein

the magnetic field is substantially perpendicular to the strong and weak electrical fields and wherein

the molecules of the inert gas pass into the enclosure through the strong magnetic field and the molecules and the ions of the inert gas pass from the enclosure through the weak electrical field.

36. A method as set forth in claim 30 wherein

the second electrode and the wafer constitute plates of a first capacitor and ions and molecules of the inert gas constitute the dielectric of the first capacitor and wherein

the wafer and the ions of the inert gas constitutes plates of a second capacitor and wherein the insulating layer of the wafer constitute the dielectric of the second capacitor and wherein

the first capacitor has a higher impedance than the second capacitor.

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37. A method of etching an insulating layer on a wafer having at least one socket, defined by walls in the insulating layer, to present a clean and fresh surface on the insulating layer, including the walls of the socket, for deposition, including the steps of:

passing molecules of an inert gas through an enclosure,

providing a strong electrical field at first positions in the enclosure to ionize molecules of the inert gas in the enclosure

providing a weak electrical field at second positions, including the positions of the wafer, in the enclosure, and

providing a magnetic field in the enclosure in a direction transverse to the directions of the first and second electrical fields in the enclosure to cooperate with the strong electrical field in producing charged particles and to cooperate with the weak electrical field in producing a transfer of the charged particles to the surface of the insulating layer in the wafer and the walls of the socket in the insulating layer at a low speed to provide a weak and controlled etching of a uniform thickness from the surface of the insulating layer and the walls of the socket without pitting the surface of the insulating layers or the walls of the socket.

38. A method as set forth in claim 37, including the steps of:

providing a first electrode in the enclosure for the strong electrical field and introducing an alternating voltage of a first particular amplitude to the first electrode to produce a strong negative DC bias on the first electrode for the creation of the strong electrical field,

providing a second electrode in the enclosure for the weak electrical field and introducing an alternating voltage of a second particular amplitude less than the first particular amplitude to the second electrode to produce a weak negative DC bias on the second electrode for the creation of the weak electrical field.

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39. A method as set forth in claim 37, including the steps of:

disposing the wafer in the enclosure in a spaced relationship to the second electrode to provide a high impedance between the second electrode and the wafer for limiting the transfer of charged particles to the surface of the insulating layer and the walls of the socket and for providing for an elimination of a substantially uniform thickness from the surface of the insulating layer and from the surfaces of the walls of the socket.

40. A method as set forth in claim 37, including the steps of:

providing a first electrode to create the strong electrical field,

providing a second electrode to create the weak electrical field,

providing magnets to create the magnetic field,

the first and second electrodes and the magnets substantially defining the enclosure, and

disposing the wafer in the enclosure in closely spaced relationship to the second electrode.

41. A method as set forth in claim 37 wherein

the wafer is at a floating potential and wherein

the magnets are substantially at a ground potential and wherein

first and second members substantially at ground potential are provided respectively in proximity to the first and second electrodes to cooperate respectively with the first and second electrodes in creating the strong and weak electrical fields.

42. A method as set forth in claim 37 including the steps of:

introducing an alternating voltage of a first particular magnitude to the first electrode to produce a strong negative DC bias on the first electrode for the creation of the strong electrical field,

introducing an alternating voltage of a second particular magnitude less than the first particular magnitude to the second electrode to produce a weak negative bias on the second electrode for the creation of the weak electrical field, and

providing a high impedance between the second electrode and the wafer and a low impedance between the wafer and the charged particles near the wafer to produce a transfer of charged particles with limited energy to the surface of the insulating layer and the walls of the socket in the insulating layer and to provide the weak and controlled etching of the surface of the insulating layer and the walls of the socket with a uniform thickness of material from the insulating layer and the wall of the socket without pitting the surface of the insulating layer or the walls of the socket.

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